3. MEGASPORES FROM SANDY SHALES ASSOCIATED WITH A LOCAL COAL SEAM EXPOSED IN THE VICINITY OF HAHAJOR VILLAGE, HURA TRACT, RAJMAHAL BASIN, INDIA

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Abstract

Megaspores are recorded from sandy shales associated with the local coal seam exposed in shallow pits in the vicinity of Hahajor Village, Godda District, Jharkhand. Almost all the megaspores are of apiculate type and represent the genera *Biharisporites* (2 spp.), *Jhariatriletes* and *Singhisporites* (1 sp. each)

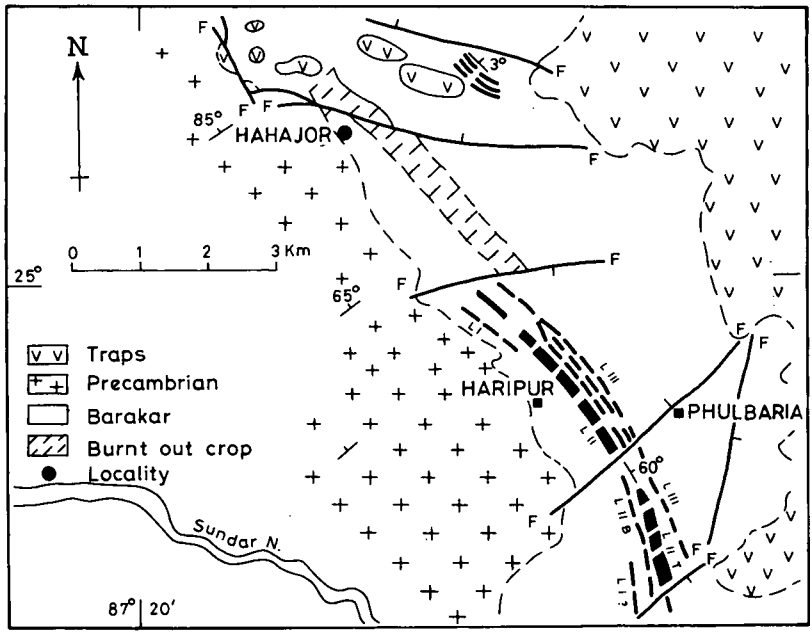
Key words: Palynology, megaspores, Barakar Fm., Rajmahal Basin, India, SEM

Introduction

A major part of the Rajmahal Basin is covered with the Rajmahal Traps with intermittent exposures of the fossiliferous inter-traps of Early Cretaceous Age. A narrow strip, on the western side of the basin and running the full length north to south, shows exposures of Gondwana sediments, mostly of Barakar Age. The northernmost outlier of these sediments contains the Lalmatia Coal Seam, which is the major coal-productive horizon in the basin (RAJA RAO, 1987). Besides the official Lalmatia Open Cast Mining Project, coal is periodically taken out by local villagers from shallow pits dug by them, particularly in the vicinity of Hahajor, Haripur and Hura Villages (Text-fig. 3.1.). These coal occurrences may also represent one of the three Lalmatia Coal Seams.

FEISTMANTEL (1881) first reported plant fossils from the area. These included a few leaves of the genus *Glossopteris*, some seeds and scale leaves. Almost a hundred years later, SINGH, SRIVASTAVA and MAHESHWARI (1986) recorded a heterophyllous sphenophyll *Sphenophyllum gondwanensis* and the equisetale *Lelstotheca* from the grey shales associated with the Lalmatia Coal Seam. Later, a much diversified flora, comprising species of the genera *Phyllotheca, Lelstotheca, Sphenophyllum, Trizygia, Vertebraria, Glossopteris, Ginkgoites, Psygmophyllum, Rhipidopsis, Saportaea, Birbalsahnia, Veekaysinghia* and some fern taxa, was recorded from the fawn, grey and black shales associated with the Lalmatia Coal Seam in different parts of the basin (BAJPAI and MAHESHWARI, 1991, BAJPAI, 1992, MAHESHWARI and BAJPAI, 1992; unpublished field data). MAHESHWARI and BAJPAI (1990) reported the presence of trace fossils in association with the plant megafossils from the Haripur area. Pollen and spores have also been reported particularly from the sub-surface sediments.

During one of the field trips to the area, we collected a few impressions of equisetalean and *Glossopteris* leaves with the weathered carbonified crust in the sandy shales associated with a local coal seam, which was being unofficically exploited by the local villagers near Hahajor Village (Text-fig. 3.1.). Chemical processing of the carbonified crust did not yield any cuticle. However, the maceration of the shales yielded a rich, though not much diversified, haul of megaspores. Identifiable taxa of these megaspores are reported in this paper.



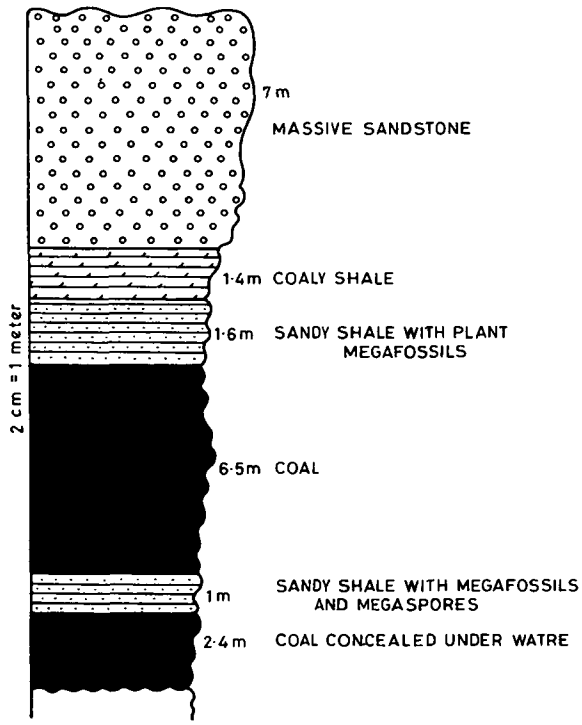
Text-fig. 3.1.

Map of the investigated area.

Materials and Methods

In the shallow pit dug near Hahajor Village, the coal was found at a depth of about 19.5 meters (Text-fig. 3.2.). The overburden comprised mostly sandy and sandy/ ferruginous shales. The sandy shale containing plant megafossils was sampled. Some samples were also collected for bulk maceration. The latter were treated with hydrofluoric acid for three to four weeks to digest the silica. The washed residue contained a very large number of megaspores, but only a few pollen and spores. The megaspores were individually picked up with a fine sable-hair brush. The megaspores were sorted under the low power binocular microscope. The megaspore population was divided into two parts, one for controlled maceration for the study of the inner structure, and the other for scanning electron micrography for study of the surface ornamentation.

For the study of the inner body (mesosporium) the megaspores were macerated in concentrated nitric acid and digested in very diluted alkali (KOH) at different stages of maceration (HØEG, BOSE and MANUM, 1955, PANT and SRIVASTAVA, 1961, BHARADWAJ and TIWARI, 1970, TEWARI and MAHESHWARI, 1992). Photomicrographs were taken at different stages of transparency. For scanning electron micrography, megaspores were dehydrated in ethanol series and then dried. The dried megaspores were mounted on aluminium stubs with silver tape, coated with gold and studied under LEO 430 Scan.



Text-fig 3.2.

Lithology of the sample site near Hahajor village

Results

Genus: *Biharisporites* POTONIÉ emend. BHARADWAJ and TIWARI 1970
Biharisporites boralii sp. nov (Plate 3.1., figs. 1,2)

Diagnosis and description. – Megaspores trilete, circular in proximal-distal view: diameter 550-670 μm in dry condition and 720-810 μm in wet condition. Trilete laesurae raised, prominent almost straight, about two-thirds of radius long. Arcuate ridges uniformly thick, clearly outlining the contact areas. Surface ornamentation of exine spinate under light microscope, spines very distinct under scanning electron microscope, differ in size and form; some with blunt tips even look like baculae. Some of the spines, particularly those in the equatorial region having highly furcated tips. Ornamentation much reduced in contact areas. Fractured surface of the exine showing usual sporopollenin units. Mesosporium distinct and without cushions.

Comparison. – The nature of the spines, particularly of those in the equatorial region distinguishes this species from other known species of the genus. In *Biharisporites robustus* PANT and MISHRA 1986, the spines have pointed tips, while in *B. (Triletes) spinulosus* (SINGH 1953) POTONIÉ 1956, the spine tips are blunt.

Holotype. - Plate 3.1., fig. 1, SEM Stub no.: 1, Birbal Sahni Institute of Palaeobotany, Lucknow.

Derivatio nominis. - After late Mr. H.N. BORAL, Technical Officer at Birbal Sahni Institute of Palaeobotany, who was a great help both in the field and the laboratory.

Biharisporites ghoshii sp. nov. (Plate 3.1, figs. 3-5)

Diagnosis and description. – Megaspores trilete, azonate, apiculate, almost circular in outline in proximo-distal view. Megaspore diameter 495-525 µm in dry condition and 655-750 µm in wet condition. Trilete laesurae imperceptibly sinuous and raised, three-fourths of spore equator in length. Due to weak arcuate ridges contact areas not sharply defined. Both the proximal and distal surfaces covered with tiny spines, with strong bases; spines very prominent in the equatorial region, tips of the spines often blunt. Spongy mesh of sporopollenin units visible in slightly over-macerated specimens. Mesoporium without cushion.

Comparison. – The species is distinguished by its characteristic surface ornamentation.The species closely compares with *Biharisporites spinulosus* (SINGH 1953) POTONIÉ 1956, but can be distinguished by its weak arcuate ridges and indefined contact areas.

Holotype. - Plate 3.1., fig. 4, SEM stub no.: 1., Birbal Sahni Institute of Palaeobotany, Lucknow.

Derivatio nominis. - After late Professor A.K. GHOSH, one of the pioneer palynologists of the country.

Genus: *Jhariatriletes* BHARADWAJ and TIWARI 1970

Jhariatriletes bharadwajii sp. nov. (Plate 3.1., figs. 6,8, plate 3.2., figs. 2-4)

Diagnosis and description. - Megaspores trilete, azonate, apiculate. Megaspore diameter 415-545 µm in dry condition and 495-695 µm in wet condition. Trilete laesurae strong, raised and extend for about three-fourth of the spore radius. Arcuate ridges not seen leaving ill-defined contact areas. The surface ornamentation appears baculate under the light microscope, but at greater magnification, under the scanning electron microscope, the individual elements appear to be hollow, with expanded bases, and open furcate tips. At one place, a small microspore seen entrapped in the maze of these appendages. Mesosporium without cushions.

Comparison. - The characteristic hollow appendages distinguish this species from *Jhariatriletes baculosus* BHARADWAJ and TIWARI 1970 and *J. srivastavae* BHARADWAJ and TIWARI 1970.

Holotype. - Plate 3.1., fig. 9, SEM Stub. no.: 1, Birbal Sahni Institute of Palaeobotany, Lucknow.

Derivatio nominis. - After late Dr. DINESH CHANDRA BHARADWAJ, who established the school of Coal Palynology at the Birbal Sahni Institute of Palaeobotany, Lucknow.

Genus: *Singhisporites* POTONIÉ emend. BHARADWAJ and TIWARI 1970

Singhisporites pantii sp. nov. (Plate 3.1., fig, 7, plate 3.2., fig. 1)

Diagnosis and description. - Megaspores trilete, azonate, apiculate. Megaspore diameter 327-410 µm in dry condition and 425-510 µm in wet condition. Trilete laesurae thick, raised straight, almost reach the spore equator. Arcuate ridges not seen, and hence

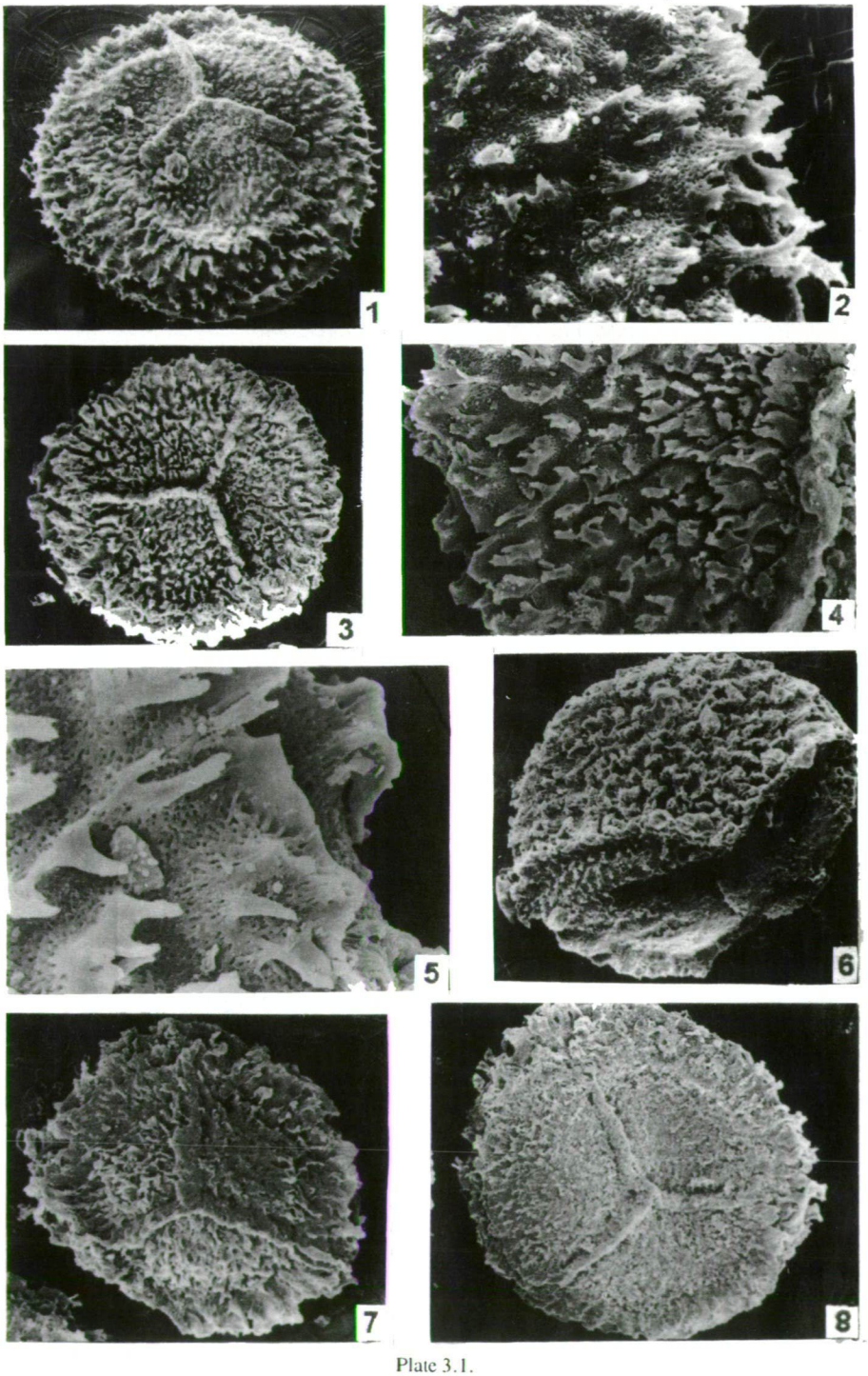


Plate 3.1.

Plate 3.1.

1. *Biharisporites boralii* sp. nov., type specimen. BSIP SEM stub no.: 1, 200x.
2. *Biharisporites boralii* sp. nov., details of exine sculpture near and at the equator, 2.500x.
3. *Biharisporites ghoshii* sp. nov., type specimen, BSIP SEM stub no.: 1, 160x.
4. *Biharisporites ghoshii* sp. nov., details of ornamentation of the exine from the trijunction of the equator, 1.500x.
5. *Biharisporites ghoshii* sp. nov., the megaspore sporoderm at a greater magnification to show the varying shapes of the spines and the spongy texture, 9.500x.
6. *Jhariatriletes bharadwajii* sp. nov., a specimen showing sporoderm ornamentation on the distal surface, 370x.
7. *Singhisporites pantii* sp. nov., type specimen, BSIP SEM stub no.: 1, 270x.
8. *Jhariatriletes bharadwajii* sp. nov., type specimen, BSIP SEM stub no. 1, 360x.

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contact areas not clearly demarcated. Exine densely ornamented with appendages of various shapes and types, ornamentation even clear on the contact faces. Ornamentation however, more developed on the distal face and on the equatorial zone. Equatorial appendages thick, comparatively close and fleshy almost giving a zonate appearance.

Comparison. - The species is distinguished by its equatorial appendages, which give the megaspore a 'zonate' appearance. Comparable species *Singhisporites radialis* BHARADWAJ and TIWARI 1970, *S. (Trilites) surangei* (SINGH 1953) POTONIÉ 1956 and *S. (Mammilaespora) waltonii* (PANT and SRIVASTAVA 1962) BHARADWAJ and TIWARI are larger in size being up to 1.000 µm in diameter.

Holotype. - Plate 3.1., fig. 10, SEM Stub no.: 1., Birbal Sahni Institute of Palaeobotany, Lucknow.

Derivatio nominis. - After late Professor DIVYA DARSHAN PANT, renowned plant biologist and palaeobotanist.

Discussion and Conclusions

Two types of megaspores, non-apiculate and apiculate, have been found in abundance in the sandy studies. The non-apiculate types do not show very distinctive characters and are referable to the *Banksisporites/Srivastavaesporites*-complex. The apiculate megaspores are referred species of the genera *Biharisporites, Jhariatriletes* and *Singhisporites.* These megaspores are believed to be those of heterosporous free-sporing lycopods (PANT and MISHRA, 1986). However no lycopod has so far been recorded from these shales or equivalent sediments in the Rajmahal Basin.

The megaspore genera *Biharisporites* and *Jhariatriletes* are long ranging: *Biharisporites* occurs in sediments of "Karharbari" ro Tiki Formations (BAJPAI, 1992, PAL, GHOSH and SANNIGRAHI, 1997). The other genus, namely *Singhisporites* is so far known only the Barakar, Kulti and Raninganj Formations (MAHESHWARI and TEWARI, 1987).

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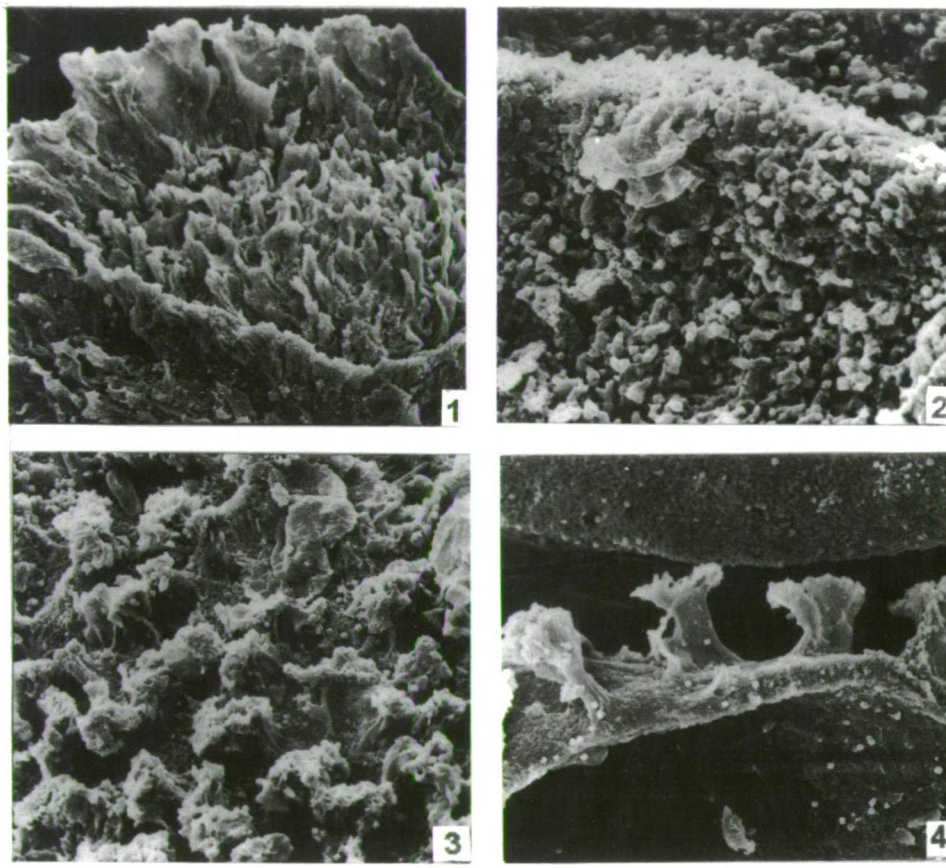

Plate 3.2.

1. *Singhisporites pantii* sp. nov., details of sporoderm sculpture in one of the proximal contact faces and at the equator, 1.800x.
2. *Jhariatriletes bharadwajii* sp. nov., details of surface ornamentation on the distal surface of the megaspore, 9.000x.
3. *Jhariatriletes bharadwajii* sp. nov., a microspore is seen entangled in the ornament elements on the proximal face, 6000x.
4. *Jhariatriletes bharadwajii* sp. nov., the characteristic hollow appendages at the equatorial region, 6.500x.

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